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SUMMARY OF RADIONUCLIDE RULE REQUIREMENTS

1. BACKGROUND

The Federal Radionuclide Rule was finalized on December 7, 2000. All community water systems must perform initial quarterly monitoring for one year for gross alpha particle activity, radium-226, radium-228, and uranium. Unless previously designated "vulnerable" by the Bureau of Safe Drinking Water (BSDW), beta particle and photon radioactivity monitoring are not required. The monitoring year for initial base monitoring is specified below. The radionuclide sampling location is now at the point of entry to the distribution system (POE). In addition, under certain conditions substitution values may be used in lieu of analyzing for radium-226 and/or uranium. The conditions which allow the use of substitution values are discussed further in this document.

As per N.J.A.C. 7:10-5.2(a)(7), the New Jersey Safe Drinking Water Act Regulations, the monitoring period for radionuclides is as follows:

Monitoring	**Water System Type**
Year 2005	All public community water systems using a surface water source(s) or all public community water systems serving a population greater than 10,000.
Year 2006	All public community water systems using a ground water source(s) serving a population equal to or less than 10,000.

The regulated parameters and their respective maximum contaminant levels (MCL) and regulatory detection limits are as follows:

Parameter	MCL	regulatory detection limit
Beta/photon emitters	4 mrem/year	4 pCi/L
Gross alpha particle activity	15 pCi/L	3 pCi/L
Combined radium- 226 and 228	5 pCi/L	
Radium-226		1 pCi/L
Radium-228		1 pCi/L
Uranium	30 μg/L	1 μg/L

The final Radionuclide Rule can be found at **www.epa.gov/safewater/rads/radfr.pdf**. An EPA guidance document is available at **www.epa.gov/ogwdw/rads/final_rads_implementation_guidance.pdf**.

SDWIS is the acronym for Safe Drinking Water Information System. The Bureau of Safe Drinking Water now uses SDWIS for managing the submitted analytical compliance data. Each analyte (contaminant) has a SDWIS Contaminant ID, usually a four digit number. The SDWIS Contaminant IDs for the radionuclide analytes on the Drinking Water Analysis – Radionuclide Reporting Form are as follows:

4002 Gross Alpha activity which includes Uranium and Radium but excludes Radon
4020 Radium-226 activity
4030 Radium-228 activity
4006 Uranium activity
URM Uranium mass
4000 Adjusted gross alpha particle activity which is the gross alpha activity result (4002) minus the alpha activity of radon and uranium

The information in the next sections will assist in the completion of the Drinking Water Analysis – Radionuclide Report Form.

2. ANALYTES

a. Gross Alpha Activity (4002)

- Initial base monitoring includes quarterly monitoring for gross alpha for four consecutive quarters. Sampling location is the point of entry to the distribution system.

- Current New Jersey regulations only allow gross alpha testing for drinking water compliance samples to be run by Method N.J.A.C. 7:18-6.4. This is also referred to as the 48 Hour Rapid Gross Alpha Test. EPA Method 900 is **not** allowed.

- Method N.J.A.C. 7:18-6.4 for gross alpha can only be run by a lab that holds New Jersey certification in this method.

- Method N.J.A.C. 7:18-6.4 for gross alpha testing requires the initial count to be initiated between 36 and 48 hours from sample collection.

- It is the gross alpha activity minus the contributions from radon that is represented by the SDWIS Contaminant ID 4002. Therefore, as specified in Method N.J.A.C. 7:18-6.4, if a gross alpha result from the initial count is greater than or equal to 5.5 pCi/L, the sample must be recounted between 20-28 hours after the initial count to eliminate radon progeny contributions to the gross alpha particle assay.

- As per Method N.J.A.C. 7:18-6.4 protocol, the gross alpha result (4002) reported by the lab should be that which includes uranium and radium but excludes radon. This is the value that should be reported on the Radionuclide Report Form.

- For determining compliance, the MCL of 15 pCi/L is for "adjusted alpha particle activity (4000)" and is defined as the gross alpha activity result minus the alpha activity of radon and uranium. When the gross alpha (4002) value is greater than or equal to 15.5 pCi/L, analysis for uranium must be performed. The resulting uranium activity is then subtracted from the gross alpha (4002) result to yield an adjusted gross alpha (4000) result upon which compliance with the MCL of 15 pCi/L is based. While it is important for the community water system to understand how compliance is measured, the adjusted gross alpha value (4000) is not entered on the Radionuclide Report Form. The actual adjustment, in those cases where uranium is separately analyzed, is done by SDWIS. The unadjusted value for gross alpha (4002) must always be entered on the Radionuclide Report Form.

- Note that if a substituted value is used for uranium, the substituted value is not subtracted from the gross alpha (4002) value to determine the adjusted gross alpha (4000) value for compliance purposes. In this case, the entire gross alpha (4002) value is assumed to equal the adjusted gross alpha (4000) value.

- The MDA (Minimum Detectable Activity) is often used interchangeably with MDC (Minimum Detectable Concentration). The MDA is the smallest concentration of radioactivity in a sample that can be detected with a 95% confidence level. An MDA is reported along with every assay result and must be entered on the Radionuclide Report Form. The MDA for a gross alpha result must be equal to or less than the regulatory detection limit of 3 pCi/L. If the MDA exceeds the regulatory detection limit, the results are unacceptable. Contact the Bureau of Safe Drinking Water for evaluation of results in this case.

- Any contaminant actually analyzed for and found to be below the EPA regulatory detection limit is considered to be zero. If the Result Value for gross alpha (4002)

is less than the regulatory detection limit, the value entered into the *SDWIS Result Field* should be "<3 pCi/l." This will allow SDWIS to assign a value of zero to the contaminant.

Two examples:

The gross alpha result (4002) was reported as 2.1 ± 0.3 pCi/L and the MDA was 1.01 pCi/L. On the Radionuclide Report Form, the value of 2.1 was entered in the Result Value Field, the value of 0.3 was entered in the Result Count Error Field and the value of 1.01 was entered in the MDA Field. The value of "<3 pCi/L" was entered in the SDWIS Result Field.

- The values of the gross alpha and radium-228 for a sample are the determining factors in the decision to use substitution values or run the assay for radium-226. Substitution allowances for radium-226 are explained further on in this document.

b. Radium-228 (4030)

- Initial base monitoring includes quarterly monitoring of each point of entry for radium-228 for four consecutive quarters. Substitution is not allowed for radium-228.

- The MDA for a radium-228 result must be equal to or less than the regulatory detection limit of 1 pCi/L. If the MDA exceeds the regulatory detection limit, the results are unacceptable. Contact the Bureau of Safe Drinking Water for evaluation of results in this case.

- As noted above, any contaminant actually analyzed for and found to be below the EPA regulatory detection limit is considered to be zero. If uranium was analyzed and the Result Value for radium-228 was less than the regulatory detection limit of 1 pCi/L, the value entered into the *SDWIS Result Field* should be "<1 pCi/l." This will allow SDWIS to assign a value of zero to the contaminant.

c. Radium-226 (4020)

- Initial base monitoring includes quarterly reporting of radium-226 activity for each point of entry for four consecutive quarters. In certain cases, substitution values based on gross alpha results can be made in lieu of sampling for radium-226. The decision to use a substitution value for radium-226 is based in part on the value of gross alpha activity and in part on the value of radium-228 activity. <u>If the combined total of the substituted value for radium-226 and the measured value of radium-228 is greater than or equal to 5.5 pCi/L, a substitution value may not be used for radium-226 because the MCL of 5 pCi/L for combined radium 226/228 will be exceeded</u>.

- If an analysis is performed for radium-226, the MDA for that analysis must be equal to or less than the regulatory detection limit of 1 pCi/L. If the MDA exceeds the regulatory detection limit of 1 pCi/L, the results are unacceptable. Contact the Bureau of Safe Drinking Water for evaluation of results in this case.

- A value for radium-226 should be reported on the Radionuclide Report Form in the SDWIS Result Field along with gross alpha and radium-228 activities. The SDWIS Result Field should be completed regardless of whether radium-226 was analyzed or substitution based on gross alpha was utilized.

- For substitution, if the gross alpha result is less than 3 pCi/L, the value of 1.5 pCi/L can be used as the substitution value for radium-226 instead of running the analysis for radium-226, provided that the substituted value for radium-226 plus the measured value of radium-228 do not equal or exceed 5.5 pCi/L. This substitution value of 1.5 pCi/L is one half the gross alpha regulatory detection limit.

- The value of 1.5 pCi/L is the only value that can be substituted for radium-226 if the gross alpha value is less than 3.0 pCi/L. Note that one half of the sample's MDA may not be used and one half of the actual reported value for gross alpha may not be used as substitution values.

  For example:

  Gross alpha was reported as 1.4 ± 0.1 pCi/L and the MDA was 1.01 pCi/L. Radium-228 was measured at 1.2 pCi/L. Since the reported gross alpha result is less than 3 pCi/L, a substitution value of 1.5 pCi/L can be used for radium-226. The water system elects to use the substitution value because the substitution value for radium-226 (1.5 pCi/L) plus the measured value of radium-228 (1.2 pCi/L) does not equal or exceed 5.5 pCi/L. The Result Value Field on the Radionuclide Report Form for radium-226 should be left blank. The value entered in the SDWIS Result Field on the Radionuclide Report Form for radium-226 will be 1.5 pCi/L.

- If gross alpha is detected at a concentration greater or equal to the regulatory detection limit of 3 pCi/L but at an amount less than 5.5 pCi/L, then the entire gross alpha activity may be substituted for radium-226 (4020) in lieu of running the analysis for radium-226 (4020). As with earlier examples, this should only be done if the combined total of the substitution value for radium-226 plus the measured value of radium-228 does not equal or exceed 5.5 pCi/L. If the combined total of the substitution value for radium-226 and the measured value for radium-228 equals or exceeds 5.5 pCi/L, the sample must be analyzed for radium-226 so that an MCL exceedence is not automatically incurred.

  Two examples:

  Gross alpha at a point of entry for a water system was measured at 3.1 pCi/L±0.6 with an MDA of 0.9 pCi/L. The radium-228 activity was 1.2 pCi/L. The water system can use the entire gross alpha value of 3.1 pCi/L as it's substituted radium-226 value because the gross alpha result is greater than 3.0 pCi/L and less than 5.5 pCi/L, and because when the substituted value of radium 226 (3.1 pCi/L) is combined

with the radium-228 result (1.2 pCi/L), the total will be less than the MCL of 5.5 pCi/L for combined radium-226 and radium-228. The Result Value Field on the Radionuclide Report Form for radium-226 will be left blank. The value entered in the SDWIS Result Field on the Radionuclide Report Form will be 3.1 pCi/L.

In another situation, gross alpha at a point of entry for a water system was measured at 3.1 pCi/L ± 0.6 with an MDA of 0.9 pCi/L. The radium-228 activity was 2.50 pCi/L. Since the gross alpha result was greater than or equal to 3.0 pCi/L and less than 5.5 pCi/L, the water system could consider using 3.1 pCi/L as a substitution value for radium-226. However, because the substitution value of 3.1 pCi/L for radium-226 plus the value for radium 228 of 2.5 pCi/L would cause an MCL exceedence, the water system must instead analyze the sample for radium-226 and report that value.

- As noted above, any contaminant actually analyzed for and found to be below the EPA regulatory detection limit is considered to be zero. If the analysis is run for radium-226 and Result Value is less than the regulatory detection limit of 1 pCi/L, the value entered into the *SDWIS Result Field* should be "<1 pCi/l.." This will allow SDWIS to assign a value of zero for radium-226.

d. Uranium (URM) (mass) and Uranium (4006) (activity)

- When the gross alpha (4002) value is greater than or equal to 15.5 pCi/L, analysis for uranium must be performed.

- For substitution, if the gross alpha result is less than 3.0 pCi/L, the value of 1.5 pCi/L can be used as the substitution value for uranium instead of running the analysis for uranium.

- If gross alpha is detected at a value greater than or equal to 3.0 pCi/L but less than 15.5 pCi/L, then the entire gross alpha activity may be substituted for the uranium result.

- The MDL for uranium must be equal to or less than the regulatory detection limit of 1µg/L (or 0.001 mg/L). If the MDL exceeds the regulatory detection limit, the results are unacceptable. Contact the Bureau of Safe Drinking Water for evaluation of results in this case.

- When uranium is analyzed, the result will be reported by the lab in either mass units or activity units, depending on the method used. However, uranium values must be reported on the Radionuclide Reporting Form in <u>both</u> mass **(URM)** units of mg/L and activity **(4006)** units of pCi/L. Because of this, the value will have to be converted from mass units to activity units or from activity units to mass units to complete the Radionuclide Reporting Form.

- When a mass method is used the result is typically reported by the lab as either μg/L or μg/Kg. The Bureau of Safe Drinking Water's analytical database, SDWIS, requires the mass of uranium to be entered in units of mg/L. Therefore, when a method is used that reports mass units of μg/L or μg/Kg , an additional step converting μg/L or μg/Kg to mg/L is required prior to converting the value to activity.

- The following instructions detail how to do the conversion:

  IF URANIUM IS ANLAYZED BY A METHOD THAT REPORTS MASS IN μg/L or μg/Kg:

  - To convert a uranium result with mass units of μg/L or μg/Kg to mg/L, divide the value in μg/L or μg/Kg by 1000. This new value is now in mass units of mg/L and should be reported in *Field **8d*** on the Drinking Water Analysis – Radionuclide Reporting Form.

  - The next step is to convert from mass of mg/L to activity units of pCi/L. Take the result in *Field 8d*, which is the uranium result in mass units of mg/L, and multiply it by 670 pCi/mg to convert the value to activity units of pCi/L. Report this value in ***Field 8e*** on the Drinking Water Analysis – Radionuclide Reporting Form.

  - Refer to Table 1 below to help in the conversion of results when the laboratory uses a uranium method resulting in mass units. The ***8d*** and ***8e*** correspond to the numbered fields on the Drinking Water Analysis – Radionuclide Reporting Form.

Table 1

Approved Methods for the Analysis of Uranium that report results in mass units of μg/L or μg/Kg	**To convert from μg/L or μg/Kg to mg/L, do the following and report the result in Field *8d***	**To convert from mg/L to pCi/L, do the following and report the result in Field *8e***
ASTM D5174-97	Divide value by 1000	Multiply *8d* value by 670
EPA 200.8	Divide value by 1000	Multiply *8d* value by 670
EPA 908.1	Divide value by 1000	Multiply *8d* value by 670
SM 7500-U C 17th edition	Divide value by 1000	Multiply *8d* value by 670
SM 3125	Divide value by 1000	Multiply *8d* value by 670
ASTM D 5673-03	Divide value by 1000	Multiply *8d* value by 670
ASTM D2907-97	Divide value by 1000	Multiply *8d* value by 670

IF URANIUM IS ANALYZED BY A METHOD THAT REPORTS IN ACTIVITY UNITS OF pCi/L:

- If a method is used to analyze uranium that reports results in activity units of pCi/L, first report that value in ***Field 8e.***

- The next step is to convert this uranium result of activity units of pCi/L into a uranium result of mass units of mg/L. Divide the value in ***Field 8e*** by 670 pCi/mg. The result is now is mg/L. Report this value in ***Field 8d.***

- Refer to Table 2 below to aid in the conversion of results when the laboratory uses a uranium method resulting in activity units.

Table 2

Approved Methods for the Analysis of Uranium that report results in activity units of pCi/L	**To complete *Field 8e***	**To convert from activity units of pCi/L to mass units of mg/L, do the following and then report the result in *Field 8d***
EPA 908.0	Use the value reported by the lab as is	Divide the value in Field *8e* by 670
EPA 00-07	Use the value reported by the lab as is	Divide the value in Field *8e* by 670
SM 7500-U C 18th, 19th 20th editions	Use the value reported by the lab as is	Divide the value in Field *8e* by 670
SM 7500-U B	Use the value reported by the lab as is	Divide the value in Field *8e* by 670
ASTM D3972-97	Use the value reported by the lab as is	Divide the value in Field *8e* by 670